LUBRICATION

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Edited by

L. H. CANFIELD, Ph.D.

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EDITORIAL

With the introduction of one new type of prime mover after another the reciprocating steam engine seems to be in a constant struggle for existence. The steam turbine with its many advantages, particularly its lower steam consumption, was the first to make an inroad upon the reciprocating steam engine. Then came the internal combustion engine, which, with its greatly increased efficiency, displaced the steam engine for many kinds of work. This is particularly true of the Diesel engine, the development of which during the last few years has been most remarkable. Now the unaflow engine, having all of the advantages of the reciprocating steam engine but at the same time showing a substantial increase in economy, is even threatening the domain which has been left to the steam engine by the turbine and the internal combustion engine.

As stated in a recent issue of *Power*:*

"The uniflow engine combines the simplicity and overload capacity of the simple engine with the economy of the compound; it has the added advantages that its overload capacity is even greater than that of the simple engine and that its economy is sustained over a greater range of load. Finally, it has few moving parts and takes up much less floor space than the compound engine. . . .

"The second reason for the economy of the uniflow engine lies in the enforced or compulsory tightness. Steam cannot leak from the live-steam space to the exhaust. If the inlet valves are leaky to any extent, the compression rises so quickly that the inlet valves clatter and give notice to the engineer that something is wrong. . . .

"It can safely be said that the uniflow engine to-day is as reliable as the simplest engine of the duoflow type."

The proper use of grease as a lubricant and its efficiency as compared with that of lubricating oil are subjects of fundamental interest to the lubricating engineer. It is with special pleasure, therefore, that we publish in this month's issue of "Lubrication" the article by Mr. Wm. M. Davis on the subject of "Greases and Their Proper Application."

* W. Trinks, "The Uniflow Engine," in *Power*, Vol. 44, No. 16, October 17, 1916, p. 570 *et seq.*

THE UNAFLOW ENGINE

By A. D. Skinner, Vice-President, The Skinner Engine Co.

THE principle of the unaflow engine is old, and, contrary to the general impression, it is an American invention. The first patent recorded in any patent office on an engine admitting the steam at the end of the cylinder and exhausting it through ports at or near the end of the stroke was a United States patent issued to B. Eaton, an American, in 1857. The advantages of the unaflow principle were clearly understood and concisely set forth in a British patent issued to J. L. Todd in 1885.

In the many articles that have been written regarding the origin of the unaflow engine and its development from the Eaton patent to the present day, not one has stated the fact that many thousand horsepower of unaflow engines were built in England from 1885 to 1900. The "Willans" engine was a central-exhaust engine in every sense of the word, and it obtained its remarkable economy largely through the unaflow principle. The "Brotherhood" engine was a true unaflow engine, although it was single-acting. The latter engine was and is still used extensively as a motive power for torpedoes. It was also built in larger sizes for marine and land service.

All these unaflow engines, however, were doomed to failure, as far as economy was concerned, because in the design of each engine was incorporated a *leaky valve*. Whatever saving was effected by the elimination of initial condensation, which is the object of the unaflow principle, was more than offset by the leakage of steam past the valve. It was not until the unaflow principle began to be coupled with valves having some semblance of steam-tightness and of remaining steam-tight after long periods of operation, that results began to be observed.

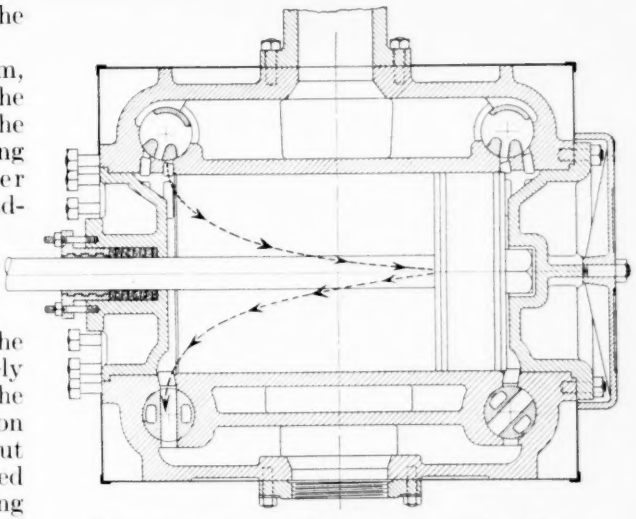
The development of the double-acting unaflow engine abroad has been entirely for condensing service, where small clearance can be employed. The unaflow principle applied to a double-acting non-condensing engine, and still maintaining that desideratum of economy, namely small clearances, is again an American invention, and is now being extensively used abroad.

In comparing the unaflow with the counterflow principle, it is perhaps well to show first the main defect of the counterflow engine, assuming that it is equipped with valves that do not leak steam. This is *initial condensation*, which in a counterflow engine takes place in the following manner:

The steam enters one end of the cylinder and, in pushing the piston before it, expands. The more it expands, the cooler it becomes. At the end of the stroke, the steam has reached the limit of its expansion in the cylinder; and the piston starts to push it out on the return stroke. The cold expanded steam is ejected through a now open port at the same end of the cylinder at which it entered. It should have been released from the cylinder at the instant it reached its limit of expansion and coldness; but, instead of this, it is held in the cylinder for the longest time possible, by reversing its flow from the direction it had on entering, and is forced to sweep back across the entire length of the

cylinder. Hence, the term "counterflow."

This expanded steam, therefore, washes the walls and head of the cylinder with a cooling effect. The cylinder heads and the walls adjacent thereto would naturally be the hottest part of the cylinder, for they are in contact with the hottest steam, namely the live steam from the boiler before expansion has taken place; but they are quickly cooled by the wiping or washing effect of the current of cold exhaust steam.



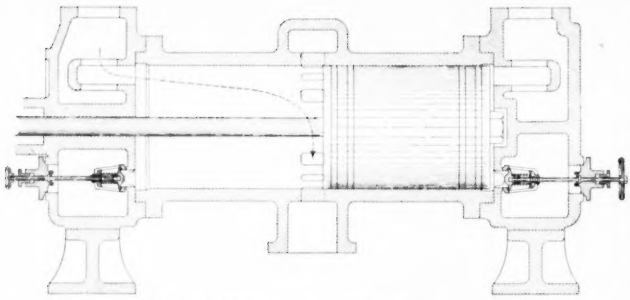
Showing Reversal of Steam in Counterflow Engine

On the next stroke, the live steam from the boiler is again admitted, and it immediately comes in contact with the cylinder head and cylinder walls which have just been cooled by the flow of exhaust steam. A certain amount is condensed, and is therefore incapable of performing work. This is what is called *initial condensation*, and exists in every form of counterflow engine.

This washing effect just described is one of the first laws of nature which were impressed upon us in our childhood days. We have all conducted the simple but impolite experiment of blowing into our soup to cool it quickly. We knew that while the air in the room was cooler than the soup, we would not have the patience to wait for the soup to become cool in the usual way. Therefore, with the only means at hand, we directed a current of air, of the same temperature as that in the room, across the surface of the soup, and quickly cooled it. It was not, therefore, the mere contact of the colder air that cooled the soup so quickly, but the successive layers of cool air washing across its surface.

It was to remedy this fundamental defect of the counterflow engine, namely initial condensation, that successive expansion stages were resorted to, as in compound or triple-expansion engines. Superheating has also been employed to overcome the above mentioned difficulty; but superheating cannot be effected without some cost in installation and operation, and much of the apparent gain in the engine due to superheating is counteracted by the decreased boiler efficiency.

With the unaflow engine, the steam enters the cylinder at the ends, and, after cut-off and expansion have taken place, it is exhausted through ports arranged around the center of the cylinder, which are uncovered by the piston at the end of the stroke. The steam has consequently a flow in but one direction, hence the derivation of the phrase "unidirectional-flow." The ends of the cylinder are therefore never cooled by the



Typical European Unaflow Engine

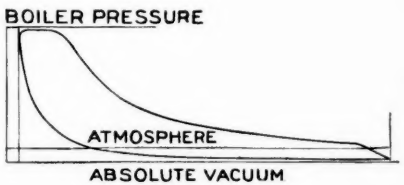
flowing of the exhaust steam across them.

Therefore, by avoiding the cooling of all clearance surfaces, in the design of the cylinder itself, it is possible to obtain in a single cylinder as many expansions, with as good or better economy, as can be obtained in any compound engine; and the practical feature of the much simpler valve gear, less cylinder and gear lubrication and higher mechanical effficiency, will appeal to all engineers.

It will be noted that, out of necessity, the piston is as long as the stroke of the engine less the width of the central exhaust ports, in order that the engine may operate with small clearances. This trunk piston has a less pressure per square inch of projected area on the cylinder walls than the low-pressure piston of a compound engine; and, if the conditions under which the piston operates are carefully studied and the method of lubricating the piston and cylinder is thoughtfully designed for these conditions, there are no lubrication troubles if a proper lubricant is employed.

In Europe practically every steam power plant operates condensing, and in the illustration depicting the flow of steam in a typical European unaflow cylinder it will be noted that the compression begins as soon as the piston covers the central exhaust ports on its return stroke. Therefore, compression takes place during ninety per cent of the stroke, for the reason that the central exhaust ports have a usual length of ten per cent of the stroke.

During this long period of compression, even with small clearances, the pressure in the cylinder does not mount above the initial pressure at the beginning of the stroke, as long as the engine is operated condensing with a fairly good vacuum, as is shown in the indicator diagram from a condensing unaflow engine.



Condensing Diagram

If the engine should be operated non-condensing, however, the compression, starting almost at the beginning of the return stroke, and with atmospheric pressure instead of vacuum in the cylinder, would become so excessive as to be detrimental to the engine, unless large clearances were employed; and the trend of steam-engine design has been toward decreasing rather than increasing the clearances.

The application of the unaflow principle adapted to non-condensing operation, and still maintaining the small clearances of the condensing unaflow engine, will be described in the next issue.

GREASES AND THEIR PROPER APPLICATION

HOT NECK GREASES

By Wm. M. Davis,
Supervising Engineer, Southern Territory
The Texas Company

THE question as to the relative merits of oils or greases as friction reducing mediums is an important one. Both lubricants have their advocates, some claiming that oils are the only fit and proper lubricants to use, while others will offer to prove that greases, if properly selected and applied, are equally as efficient and more economical than oil. Those who have made a careful study of lubricants and their proper application agree, however, that both oils and greases have their spheres or ranges of usefulness, that there are many places where only oil can be used and where the use of grease would be ruinous to the machinery; and on the other hand, that there are many places and many kinds of machinery where greases, if properly chosen, will give the best and most economical results, and where oils, if used, would be extremely wasteful. The latter is especially true in the case of plants where the machinery is exposed to dirt, dust and grit, such as cement mills, ore concentrators, quarries, etc., as grease tends to act as a seal and prevent gritty matter from getting between the wearing surfaces. On the other hand, all machinery running at high speed and heavy pressure per square inch of area, and especially such as is fitted with ring oiled bearings or with oiling systems so that a continuous flow of oil can be maintained without loss, should be lubricated with oil. To use grease on such a bearing would be to invite disaster.

All lubricants that are known under the general names of Cup Greases, Sponge or Fibre Greases, etc., are really mineral oils thickened with soap. That is, they are made by saponifying a fatty oil, either animal or vegetable, by means of an alkali. The saponifiable oil used for making the soap is usually lard, horse, tallow, palm or cottonseed oil. The alkalis used to change the oil into a soap are usually common unslaked lime, soda ash or potash, the alkali being dissolved in water and mixed with the oil in a steam heated kettle until the combination is complete. To this mixture a sufficient amount of petroleum oil is added to bring it to the desired consistency.

As the soap itself has but little lubricating value, the value of the grease as a lubricant depends to a great extent upon the quality of the petroleum oil used in its composition. About all the soap does is to help hold the petroleum oil in a plastic form and give the mixture the necessary melting point.

Grease, as it appears to the eye, is a very deceptive substance. The properties of grease, with the exception of the melting point, cannot be determined without a somewhat complicated and tedious chemical analysis, and even then, the determination will not tell us which of two or more greases is the better lubricant.

One grease, because the high acid content of the fatty matter has not been properly neutralized by the

alkali, and because of the low or inferior quality of the petroleum oil would be of such poor quality as to result in damage to the metal wherever used.

On the other hand, another grease, which may look and feel exactly like the first, will, on account of the low acid content, freedom from alkali and the high quality of the petroleum oil used, be a most excellent lubricant. So in ordering grease it is a good safe rule to buy only of firms with established reputations for putting out only goods of high quality.

There is no accepted method of testing or measuring the relative hardness or softness of grease. The melting point does not indicate this. A grease may be quite hard at ordinary room temperature, yet would be fluid at 120 degrees Fahrenheit; another grease, which at room temperature, say 80 degrees F., would be quite soft, would not become fluid under 160° F.

It is the practice of several manufacturers of greases to number them according to their degree of density, beginning with No. 0 for soft and No. 5 for the hardest grades, the No. 5 grade usually being hard enough to be broken out of the barrel in lumps. Such greases are usually known under the general name of Cup Greases, they being forced into the bearing or journal by means of grease cups.

It might be well to state here that it has been the experience of the writer that while there are dozens of kinds of compression grease cups on the market, the best and most reliable are the hand compression cups, in which the grease is forced out by hand. Those which depend upon springs to feed the grease are often unreliable and usually more expensive. With spring actuated cups one must be very careful in the selection of the grease; if too hard, the spring will not be strong enough to force it through to the journal or pin; if too soft, it may feed out too fast.

In selecting the proper grade of grease, so as to get the best and most economical results, one must have some knowledge of the service to which it is to be subjected. For use on machinery running at high speed and light pressure, such as the top rolls of spinning and twisting frames in textile mills, in the gear cases of automobiles, etc., a very thin grease should be used, such as No. 0 or No. 1. For general mill machinery, where the speeds and the pressures are moderate, No. 3 will be best to use. Where the surface speed is quite slow and the pressure per square inch of contact area is ample, as is the case with some kinds of mill machinery, a grease of about the consistency of No. 5 grade will be the best and most economical to use.

The above mentioned cup greases have a moderately high melting point, from 130° F. to 160° F., and are suitable for use on machinery running at moderate temperatures, that is, where the temperature does not go but a few degrees above the temperature of the room.

There is, however, in some kinds of manufacturing plants, machinery the bearings of which are exposed to radiant heat of the material in process of manufacture, such as the rotary kilns and stone dryers in cement mills, the dryer rolls in paper mills, ore roasting machinery in smelters, etc., where the temperatures are so high that ordinary cup grease would soon melt and run away. For this service a grease should be used that is moderately soft at room temperature, yet has a

high melting point. Greases that have these properties are known under the general name of "Sponge" or "Fibre" Greases, as instead of being smooth and homogeneous in texture, they have a spongy or fibrous appearance.

Greases, having such a high melting point, often 225° to 275° F., resist the action of the radiant heat and yet are soft enough to spread over and lubricate the wearing surfaces. These greases are nearly always used on large open bearings, where the opening or space in the cap is large enough so that the grease can be packed directly on the journals. This sponge or fibre grease is sometimes mixed with wool waste, such as is used in packing car journal boxes. The waste helps to hold the grease in place and prevents it wearing away too fast.

There is one phase of lubrication that the writer was intimately connected with for about four years, that few persons other than those in sheet steel and tin plate mills ever become acquainted with. While Lubrication Engineer for a sheet and tin plate manufacturing corporation, the biggest problem the writer had to handle was the economical lubrication of the journals or "necks," as they are called, of the rolls used in rolling out the steel sheets.

As the steel is at a red heat while being rolled, the body of the rolls also becomes very hot. The heat radiating to the necks makes it necessary that a very refractory or heat-resisting grease be used. In fact the roll necks sometimes get so hot as to cause the grease to burn. It is needless to explain that an ordinary babbitted bearing would not last very long under such treatment, and only hard brass or bronze bearings can be used.

The grease for this service is nothing like the ordinary cup or sponge grease, it having for its base a heavy petroleum oil which has been combined by a boiling process with a suitable saponifiable medium and an alkali into a grease that is jet black in color and of about the consistency of stiff putty.

New grease is never used on the roll necks, the bearing being lubricated with what is called "Re-boiled" grease. The grease is applied to the necks with an asbestos swab on the end of an iron rod. The grease is kept melted in a kettle over a gas fire, or in a pan heated by means of hot "crop ends," that is, the rough ends of the sheet bars that have been heated in the sheet bar furnace and then placed under the pans so as to keep the grease soft enough to apply to the roll necks. In some mills it is the practice to cut the re-boiled grease up into strips about an inch square and 6″ or 8″ long and apply them directly to the neck. This is called "chunking the necks." Every sheet steel or tin plate mill is provided with a kettle of sufficient capacity to hold one or two tons of what is known as "recovered" grease, the kettle being set over a brick work furnace.

The grease is applied to the necks with the swab by the "catcher," who stands on the opposite side of the rolls from the "roller." He catches the red hot steel with a pair of tongs and passes it back over the top of the upper roll to the "roller" for another pass through the rolls. A swabful of grease is applied to the necks every ten or fifteen minutes. Most of this grease drips off and falls down into the pit under the roll housing. At the week end, when the mill is shut down, the grease, which has become to a certain extent hard

and brittle from contact with the hot neck surfaces, is shoveled out and taken to the grease house.

The grease house man then screens it to get out the mill scale and other dirt, shovels it into the kettle, adds some new hot neck grease and a sufficient amount of a heavy bodied petroleum oil to soften it, starts a fire in the furnace under the kettle and melts the whole mass into a fluid mixture, and then allows it to run out into a sheet metal or brick work pan about twelve or fifteen feet square and four or five inches deep, the pan being first coated with whitewash or graphite to prevent the grease from sticking. When the grease has become cold it is cut up into chunks and issued for use again on the roll necks.

When the writer took charge of the lubricating matters of the above mentioned corporation he found a great diversity of methods in the re-boiling and use of hot neck grease, most of them very inefficient and wasteful, so that the cost amounted to a good many thousands of dollars a year.

After several weeks spent in noting the methods at the various mills, gathering data on amount used and cost, temperatures of roll necks, etc., finding out just why the cost was high at one plant and low at another making the same class of product, he formulated the following rules and instructions:

DIRECTIONS FOR RE-BOILING AND WORKING HOT NECK GREASES

First—All used or recovered grease, before being put in the kettle, should be thoroughly screened to free it from mill scale and other foreign matter, and care taken to see that the fine particles of grease are not thrown out with the dirt and scale.

Second—Put enough new grease and oil into the kettle to soften the batch and make up the loss. The amount required can only be determined by experience. It will depend largely on the hardness of the recovered grease, and the percent of loss in the mill. The harder the return grease the more new grease and oil will be needed; the softer the recovered grease the less will be needed.

Third—The batch should be gotten ready in the afternoon and a slow fire started under the kettle, the night watchman or a laborer being required to look after it during the night and stir the batch occasionally. This causes the grease to melt and become thoroughly mixed. The usual practice of starting the fire in the furnace in the morning and melting the batch in a few hours is bad, as too intense a fire and too rapid heating tends to burn the oil, leaving the grease too hard. It is the oil in the grease that lubricates. The lower the temperature at which the batch can be melted, the richer the grease will be.

Fourth—After the grease has become thoroughly melted it should be allowed to stand for an hour or so before being run out in order to allow any dirt that may be in it to settle to the bottom of the kettle.

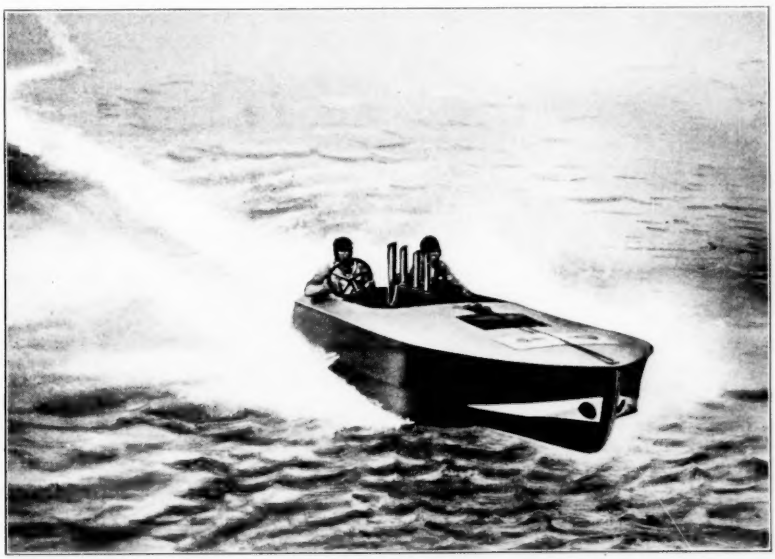
Fifth—Before running the grease, the cast bed or pan should be coated with whitewash or a mixture of cheap graphite and water to prevent sticking. When cold, the grease should be cut up into cakes about a foot or eighteen inches square, weighed and piled up in the grease house.

By keeping a record of the weight of the old and new grease and oil put into the kettle and the weight of the re-boiled grease, the amount of loss due to boiling can be obtained.

Sixth—After the kettle has been emptied and before it has become cold, it should be thoroughly scraped, and all dirt and sediment removed. This is very important as the sediment, if allowed to collect, will in time become so thick and hard as to require an intense heat in order to melt the batch, this tending to burn the oil.

Seventh — All re-boiled grease, when issued, should be charged to the mill or set of rolls on which it is to be used. Care should be taken in heating the grease in the mill to use only just sufficient heat to soften the grease so that it will stick to the swab.

As stated above, the lower the temperature at which the grease is worked, the less the liability of burning the oil. Always remember that it is the oil in the grease which makes it a lubricant, the other ingredients only serving to change the oil from a fluid to a plastic form.



"MISS MINNEAPOLIS"

Winner of the American Power Boat Association Gold Challenge Cup, 1916

UNDOUBTEDLY the most severe test that a motor oil can be subjected to is in the engine of a racing motor boat or hydroplane. The continuous strain on such an engine is greater than that upon an internal combustion engine in any other class of work and our engineers agree that it requires the very highest class oil to lubricate these engines satisfactorily. TEXACO Motor Oil Extra Heavy has been used by racing motor boats all over the country for some years and in

all cases has given the perfect lubrication required by this extreme service. Perfect lubrication for such an engine means that the film of oil has been maintained at all times, that no hot bearings have been developed, that the oil has not decomposed causing a material reduction of its lubricating quality, and finally an absence of carbon and of the many troubles that come from carbon.

All of the boats mentioned in the following list of Gold Cup Records were lubricated with TEXACO Motor Oil Extra Heavy:

GOLD CUP RECORDS

Winning Boat, 1916	*Time*	*Statute M. P. H.*
First heat, Miss Minneapolis	44:41	46.2
Second heat, Miss Minneapolis	41:46	49.5
Third heat, Miss Detroit	41:20	50.0
Total race, Miss Minneapolis	2:07:48	48.6

One Heat, 30 Nautical Miles

Made by Baby Speed Demon II at Lake George in 1914—
Time, 41:03. Speed, 50:49 stat. M. P. H.

Three Heats, 90 Nautical Miles

Made by Baby Speed Demon II at Lake George in 1914—
Time, 2:06:35. Speed, 49.12 stat. M. P. H.

DISTURBER IV'S RECORD

Fastest Race at Chicago, 1915, 54:326 M. P. H. Fastest Lap 54.90 M. P. H.

"Miss Minneapolis," a 20-foot hydroplane built by the C. C. Smith Boat & Engine Company, of Algonac, Michigan, won the Gold Cup Races at Detroit in September and is now crowned "The Marine Speed Queen." In the final run of five miles her average speed was 55.8 miles per hour. It was only in the one-mile trials that "Miss Minneapolis" was extended to anywhere near her limit of speed, and in these trials she established a record of 61.08 statute miles per hour, and her fastest mile was at the rate of 63.578 miles per hour.

We are quoting below a letter received from Mr. C. C. Smith, President of the C. C. Smith Boat & Engine Company, just before the Gold Cup Races:

Algonac, Michigan, Aug. 21, 1916.

THE TEXAS COMPANY,
Chicago, Ill.

Gentlemen:—Enclosed please find check for $15.90 to pay for our last shipment of TEXACO Motor Oil Extra Heavy. We herewith want to order for immediate shipment by Adams Express 40 gallons in 5-gallon cans of TEXACO Motor Oil Extra Heavy. We would also say to you that since the races in Peoria in 1914 we have used your TEXACO Motor Oil in the Baby Speed Demon, Baby Reliance, Buffalo Inquiry, Miss Detroit and Miss Minneapolis and up to the present time we have never had to remove a bearing on account of lubrication or for the inefficiency of the oil. This may be of some value to you as an advertisement.

Please give this order your prompt attention. We want the oil to drive next Saturday in the Gold Cup Races at Detroit.

Yours very truly,

(Signed) C. C. SMITH BOAT & ENGINE CO.
Per C. C. Smith, *Pres.*

REPORTS OF ENGINEERS AND SALESMEN

CRATER COMPOUND

Another example of the phenomenal success of Crater Compound is culled from recent reports of Mr. C. B. Leggett on a large chemical plant in his territory. In June last Mr. Leggett, of the New York District, succeeded in getting the chief engineer of this concern to purchase a camel hair belt to be used on a motor drive to a nitric acid mixer. The room in which the belt is used is dark and wet, the nitric acid mixer being directly over the belt, which is subject to the acid drippings. On account of the belt being cemented, the manufacturers refused to lay the belt up in Crater Compound as they claimed the heat used in the saturating bath would open up the joint. The chief engineer, however, treated the belt with a heavy saturation of Crater Compound and was so pleased with the outcome of his experiment that he has decided to order all his belts laid up in this lubricant. Mr. Leggett reported later that the superintendent of the plant had examined this belt and had expressed the opinion that Crater Compound was "too good," that is, the men running the machine, knowing the lasting qualities of the Crater treated belt, became careless and allowed the acid to drip more than was necessary.

The average life of a belt on this work is from six to twenty days, according to the amount of acid dripping on it, and the following and latest report from Mr. Leggett tells the story of Crater:

The belt we laid up in Crater Compound ran continuously 67 days, and was taken off about two weeks ago to allow repairs to be made to the mixer on which it had been used. The belt showed absolutely no wear from the effects of the acid, although the Crater had practically disappeared from the surface. The only part of this belt showing any wear was the edge, where they had used a piece of wood as a pulley guide. Of course this has nothing to do with the working of Crater. The master mechanic to-day advised that he would adopt this as their belt dressing. Sold them a barrel of Crater on the performance of this belt.

In August, 1915, a large user of wire drilling lines had aboard of S. S. "El Sud," which was stranded in Galveston Bay during the hurricane, four 3500′ drilling lines, which had been laid up by the manufacturer in Crater Compound. After many days a portion of the cargo was recovered and removed to the wharf. The four drilling lines were among the articles recovered, but the most experienced driller would never have recognized the four piles of mud, soaked with salt water, as drilling lines.

After the mud had been removed, the four lines were started on a thousand-mile railroad journey, during which trip the salt water soaked burlap wrapping remained wrapped around the wires on the spools. After fifty-three days of such treatment, these four drilling lines were delivered to their respective drilling rigs, and after the tools were "strung up" a careful inspection was made of the lines, the result being that not a trace of corrosion was found, nor could four prettier lines be found on any drilling rig. Since that date, over one year ago, these lines have been in constant use, and are prepared to stand a vigorous winter regardless of their exposed positions.

The Producers Oil Company has been using Crater Compound as a chain belt lubricant for considerably over a year and the report that they have received from the men who have been using it has been very gratifying. We quote two letters from field superintendents relative to this lubricant:

"We find Crater Compound is giving good results on chains and sprockets and is very much better than any other lubricant we have ever used, as our chains and sprockets are lasting much longer since we began using Crater Compound."

"Crater Compound as a chain belt

dressing eliminates the wear fifty per cent and the noise seventy-five per cent. We find this lubricant very satisfactory for any other parts of drilling rig machinery that need grease."

TEXACO URSA OIL

Some time ago Agent Newton and I sold a gin and fertilizer company their initial order of lubricating and fuel oil for their new 40 h.p. Fairbanks-Morse engine which they were then installing.

The erecting man from the engine works stated that in all his experience with gas engines he has never seen an oil the equal of Ursa Oil. He stated that there was a time when he thought that we were asking too much for Ursa Oil, but after seeing what it would do and the class of lubrication it gave he was thoroughly convinced that it was the cheapest oil made for this class of work at any price.

FRANK J. DAVIS.

The Munroe, in the engine of which we are using Ursa, encountered very rough weather on her last trip and anchored in the shoals. The sea became so rough, however, that the Captain decided it was dangerous to remain, and put out to sea. During all this rough pummeling, the engine never missed a stroke. This good showing was attributed to the excellence of Ursa Oil.

Anyone who has crossed the shoals in rough weather knows what this means—but Ursa brought the ship home.

S. C. EBERHARDT.

Secured an order for one wood barrel of Ursa Oil. Also had a talk with the engineer, who told me that he was convinced beyond a question of doubt that Ursa was the most suitable oil for his Bruce MacBeth Gas Engines. He removed a piston a few days ago and found absolutely no carbon on it or under the rings after four months run, and the cylinder is well lubricated. He stated that he did not know anything about cleaning spark plugs after he began the use of Ursa Oil.

J. N. PREWITT.

TEXACO SERVICE

MUNICIPAL PLANT, Tallahassee, Fla.

On June 21st I was instructed to proceed to Tallahassee, Fla., to try to correct engine trouble at the above plant. The engine in question is a Skinner Cross Compound, 17½x28x16, running 225 r.p.m. The engine had been out of commission about a week as trouble had gone so far that they could not run it more than about 1½ hours at a time, and finally they abandoned the engine altogether and were waiting for a Skinner engine expert.

In beginning my work I first tried to run this engine to see just what the conditions were. In just one hour and forty-five minutes we went down all in a heap with every bearing ready to burn out. The temperature of the high pressure side main bearing was just 170° F. It was a shame to abuse the engine and that good CETUS OIL that way, but we had seen all the conditions. In this short run I had indicated both sides, so I had it all. We took the engine all down, main bearings, connecting rods, took out all quarter boxes, and proceeded to line up. Getting our lines up we found that the crank shaft was 13/64ths of an inch out of line. No wonder everything ran hot. No oil on earth would run this engine in this condition. Having lined up, all quarter boxes had to be scraped in, also crank pin brasses, cross head pin brasses, and everything had to be worked over. But finally, on Tuesday, the 27th, and Wednesday, the 28th, we had the satisfaction of seeing this engine run as pretty as when the erectors left her. On the first tryout on Tuesday temperatures ran up as high as 140° F., but in about two hours the temperatures began to fall, and at ten o'clock at night 128° F. was the highest temperature we had and the engine was running as smoothly as a sewing machine.

WM. G. HARVEY.

The following letter is of interest in connection with the above report:

Tallahassee, Fla., June 28, 1916.

MR. D. A. VANN, S. E. Representative,
THE TEXAS COMPANY,
Atlanta, Ga.

Dear Sir:—Your Mr. Wm. G. Harvey has been with us for several days, going over our Skinner Compound engine. This engine was in very bad shape. Had developed a very bad knock which we were unable to get rid of. He has put the engine in excellent running condition and we are very much pleased with his work. We congratulate you on having in your employ such an excellent mechanic. We wish to assure you and Mr. Harvey of our appreciation for this servee rendered.

Yours very truly,

D. R. SWING,
Supt. Board of Public Works,
City of Tallahassee.